

Forest Fragmentation

Q: What are the trends in the extent and distribution of the Nation's ecological systems?

The above question pertains to all 'Extent and Distribution of Ecological Systems' Indicators, however, the information on these pages (overview, graphics, references and metadata) relates specifically to "Forest Fragmentation". Use the right side drop list to view the other related indicators on this question.

Introduction

The amount of forest land in the U.S. monitored by the U.S. Department of Agriculture (USDA) Forest Service has remained nearly constant over the past century, but the patterns of human land use have affected its distribution from one region of the U.S. to another. Forest fragmentation involves both the extent of forest and its spatial pattern, and is the degree to which forested areas are being broken into smaller patches and pierced or interspersed with non-forest cover.

Forest fragmentation is a critical aspect of the extent and distribution of ecological systems. Many forest species are adapted to either edge or interior habitats. Changes in the degree or patterns of fragmentation can affect habitat quality for the majority of mammal, reptile, bird, and amphibian species found in forest habitats (Fahrig, 2003). As forest fragmentation increases beyond the fragmentation caused by natural disturbances, edge effects become more dominant, interior-adapted species are more likely to disappear, and edge- and open-field species are likely to increase.

This indicator of forest fragmentation was developed by the USDA Forest Service. The indicator is based on the 2001 National Land Cover Database (NLCD), which was constructed from satellite imagery showing the land area of the contiguous U.S. during different seasons (i.e., leaves-on and leaves-off) around the year 2001 (Homer et al., 2007). The USDA Forest Service's Southern Research Station performed a re-analysis of the NLCD, aggregating the four NLCD forest cover classes (coniferous, deciduous, mixed, and wetland forest) into one forest class and the remaining land cover classes into a single non-forest class (USDA Forest Service, 2007). A model that classifies forest fragmentation based on the degree of forest land surrounding each forest pixel (a square approximately 30 meters on each edge) for various landscape sizes (known as "windows") provides a synoptic assessment of forest fragmentation for the contiguous U.S. by assessing each pixel's "forest neighborhood" within various distances.

Results are based on four degrees of forest cover: "core" if a subject pixel is surrounded by a completely forested landscape (no fragmentation), "interior" if a subject pixel is surrounded by a landscape that is 90 to 100 percent forest, "connected" if a subject pixel is surrounded by a landscape that is 60 to 90 percent forest, and "patchy" if the subject pixel is surrounded by less than 60 percent forest. The window (landscape) size used for this analysis was 13 by 13 pixels, 390 meters on each edge, or about 15.2 hectares (37.6 acres). The window is shifted one pixel at a time over the map, so the target population for the indicator is all forested pixels in the contiguous U.S. Percent forest was resampled from 30-meter pixel data and aggregated by state to develop the EPA Region-specific breakouts.

What The Data Show

Slightly more than 26 percent of the forested pixels in the U.S. represent "core" forest, i.e., landscapes dominated by forest (Exhibit 6-5). However, the data for "interior" and "core" forests

suggest that fragmentation is extensive, with few large areas of complete, unperforated forest cover. About 19 percent of forest pixels in the U.S. occur in a landscape where less than 60 percent of the “neighborhood” is forest (i.e., forest cover is “patchy”).

There is considerable regional variation in forest fragmentation (Exhibit 6-5). Regions 1, 2, and 3 have more than 30 percent “core” forest pixels, while fewer than 20 percent of the forest pixels in Region 7 are “core” forest. From the opposite perspective, fewer than 10 percent of forest pixels in Region 1 are surrounded by less than 60 percent forest, compared to almost 40 percent of the forest pixels in Region 7.

Exhibit 6-5. Forest fragmentation in the contiguous U.S. by EPA Region, based on 2001 NLCD^{a,b}

Degree of forest cover:^c

Core	Interior	Connected	Patchy
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Percent of forested pixels in each category:

Region 1	38.0	26.7	27.8	7.5
Region 2	33.5	23.5	28.7	14.3
Region 3	33.3	23.6	30.3	12.8
Region 4	22.1	23.1	35.9	19.0
Region 5	21.4	22.8	33.8	22.0
Region 6	23.0	21.0	32.3	23.7
Region 7	15.6	15.4	31.0	38.0

Region 8	27.8	22.8	29.2	20.2
Region 9	29.7	22.5	29.4	18.4
Region 10	29.4	26.0	31.9	12.8
All U.S.	26.1	22.9	32.1	18.9

^a **Coverage:** Areas of the contiguous 48 states classified as “forested” by the 2001 National Land Cover Database (NLCD).

^b Totals may not add to 100% due to rounding.

^c See text for definitions of forest cover categories.



Data source: USDA Forest Service, 2007

Limitations

- Trend information is not available for this indicator. Although earlier land cover data are available as part of the 1992 NLCD, they are not directly comparable with the 2001 NLCD due to differences in classification methodology. Efforts to compare these two products are ongoing.
- The apparent degree of connectivity depends on the size of the window. In a similar analysis of 1992 NLCD data, Riitters (2003) determined that the percentages for all categories (especially “core” and “connected” forest pixels) decrease rapidly as the size of the window is increased progressively from 18 to 162, 1,459, and 13,132 acres.
- Because the non-forest land cover classes were aggregated, this indicator does not distinguish between natural and anthropogenic fragmentation (although such a distinction has been made for global fragmentation by Wade et al., 2003).

- The data do not include Hawaii or Alaska, which account for about 1 out of every 6 acres of forest land in the U.S.

Data Sources

An earlier version of this analysis was published in Riitters (2003) and Heinz Center (2005). The analysis presented here has not yet been published; data were provided by the USDA Forest Service (2007), and EPA grouped the results by EPA Region. This indicator is based on land cover data from the 2001 NLCD (MRLC Consortium, 2007).

References

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